An efficient likelihood-free Bayesian computation for model selection and parameter estimation applied to structural dynamics

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Résumé en anglais	Model selection is a challenging problem that is of importance in many branches of the sciences and engineering, particularly in structural dynamics. By definition, it is intended to select the most plausible model among a set of competing models, that best matches the dynamic behaviour of a real structure and better predicts the measured data. The Bayesian approach is based essentially on the evaluation of a likelihood function and is arguably the most popular approach. However, in some circumstances, the likelihood function is intractable or not available even in a closed form. To overcome this issue, likelihood-free or approximate Bayesian computation (ABC) algorithms have been introduced in the literature, which relax the need of an explicit likelihood function to measure the degree of similarity between model prediction and measurements. One major issue with the ABC algorithms in general is the low acceptance rate which is actually a common problem with the traditional Bayesian methods. To overcome this shortcoming and alleviate the computational burden, a new variant of the ABC algorithm based on an ellipsoidal nested sampling technique is introduced in this paper. It has been called ABC-NS. This paper will demonstrate how the new algorithm promises drastic speedups and provides good estimates of the unknown parameters. To demonstrate its practical applicability, two illustrative examples are considered. Firstly, the efficiency of the novel algorithm to deal with parameter estimation is demonstrated using a moving average process based on synthetic measurements. Secondly, a real structure called the VTT benchmark, which consists of a wire rope isolators mounted between a load mass and a base mass, is used to further assess the performance
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